Lat 39.40504 Lon -120.64488

Forest Pest Management

Pacific Southwest Region

File Code: 3420 Date: July 16, 2001

Subject: Forest Insect and Diseases, Stand 435-2035 Carr/Feeley Compartment (NE01-06)

To: District Ranger, Nevada City RD, Tahoe NF

At the request of Gary Cline and Kevin Zimlinghaus, Forest Pest Management evaluated two aggregations in stand 435-2035 on October 26, 2000 to identify insect and diseases that may be causing tree mortality or affect future management. Bill Woodruff (plant pathologist), Rick Turcotte (entomologist) and Danny Cluck (biologist) conducted the evaluation with Gary and Kevin.

Stand 435-2035 is located in the Carr Lake area of the Nevada City District of the Tahoe National Forest. This mixed conifer stand is site class 2 and 91 years old. Timber production is one of the management objectives for this stand. A project to remove hazard trees along the roads in this area was completed 3 years ago. Two adjacent shelterwood harvests were completed within the last 15 years.

Insects and Diseases in Aggregation A (10 acres)

Ponderosa pine, sugar pine, white fir, Douglas fir, incense cedar and black oak are growing in aggregation A. The average stocking is 118 trees/acre and 460 seedlings/ac. The mean diameter is 19 inches. The average basal area is 224 sq.ft./ac. and the basal area growth is currently 5 sq.ft./ac/yr. The Forest Service Silvicultural Practices Handbook lists the Tahoe desired basal area for this aggregation as 223 sq.ft. The "desired" basal area should

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probably be something less than 223 sq.ft. to compensate for the added stress caused by root disease.

Some of the white fir trees are probably infected with Annosus root disease caused by the fungal pathogen *Heterobasidion annosum*. This pathogen was positively identified by the presence of annosus conks on true fir stumps a short distance away in aggregation B and symptomatic white fir trees are present in aggregation A. Annosus conks were not found in aggregation A. Douglas fir is also a host for the s-type annosus that infects true fir. Root disease generally becomes more apparent as trees become stressed by environmental factors. Less vigorously growing trees are often more susceptible to the effects of root disease than vigorous trees.

Mycelial fans and rhizomorphs of armillaria root disease, caused by *Armillaria ostoyae*, were found in aggregation B under the bark of an old white fir stump. Although it wasn't found in aggregation A, armillaria is probably present. Armillaria lives as a decay organism in living or dead conifer and hardwood trees or stumps. In some cases, however, armillaria becomes actively parasitic and aggressively kills older trees. In stand 435-2035, armillaria is probably functioning as a decay organism and not as a pathogen. If a clearcut harvest is implemented where armillaria root disease is present as a saprophyte, the disease often becomes parasitic and kills conifer seedlings that are planted. This is often happens when all oak trees infected with armillaria root disease are cut in a harvest unit. Armillaria can also become parasitic when trees become stressed.

No other insect or pathogen was found to be significantly affecting the trees in aggregation A. Occasional borer or bark beetle attacks and a small amount of white pine blister rust were seen, but none of these were significantly affecting the stand.

Insects and Diseases in Aggregation B (27 acres)

A 50/50 mix of white fir and red fir are growing in Aggregation B with an occasional Jeffrey pine tree (estimate 1 JP/ac). The average stocking is 263 trees/acre and no seedlings/ac. The mean diameter is 16 inches. The average basal area is 353 sq.ft./ac. and the basal area growth is currently 3 sq.ft./ac/yr. which is 40 percent less than the basal area growth of aggregation A. Some of this reduced growth is likely due to the presence of annosus root disease. The Forest Service Silvicultural Practices Handbook lists the Tahoe desired basal area for this aggregation as 313 sq.ft. The "desired" basal area should probably be something less than 313 sq.ft. to compensate for the added stress caused by root disease.

As stated above, annosus and armillaria root diseases were positively identified on true fir stumps in aggregation B. At this time, the armillaria is probably living as a saprophyte, and not adversely parasitizing healthy conifers. In the vicinity of the stump with the annosus conk there are ten or more stumps from trees removed as hazard trees three or more years ago. In the mid 1990's, these white and red fir trees were probably stressed and killed by

the combined effects of prolonged below normal precipitation, overstocking, root disease (*Armillaria spp.* and s-type *H.annosum*), and bark beetles (fir engraver = *Scolytus ventralis*). Annosus root disease is probably present in the roots of many of the true fir trees in both aggregations A and B. Unlike with annosus root disease in pine (p-type annosus) where annosus infects the sapwood at the root collar and rapidly kills infected pine trees, s-type annosus infects the heartwood of mature host trees. Because of this, true fir trees infected with s-type annosus can survive as long as they remain vigorous and grow new wood and roots faster than the disease can rot the wood. An exception to this is that young host trees can be killed rapidly by s-type annosus root disease. When too much of the wood fiber in the roots of diseased fir trees is destroyed by annosus root disease, the trees become weak and subject to windthrow or they become stressed during prolonged periods of below normal precipitation and are killed by fir engravers. If the objective is to retain mature fir trees in areas where root disease is present, it is necessary to aggressively thin the trees so that they can grow vigorously. In cases where a stand is devastated by annosus root disease, it may be necessary to remove all the host trees for 30 or more years to allow time for the disease in all the roots to die.

Alternatives

No action

Currently, the basal area of aggregation A is at the Tahoe desired. The basal area of aggregation B is 13 percent over the Tahoe desired. Without management, the basal area of the aggregations will continue growing which will add stress to the trees. During the next prolonged period of below normal precipitation the trees will be stressed by heavy stocking and root disease. *Armillaria spp.* may become parasitic. Some trees in both areas will be stressed and killed by root disease and/or beetle attacks. The amount of mortality will be proportional to the lack of precipitation and the severity of root disease. Increasing numbers of fir with roots weakened by root disease will blow over.

Thinning to reduce the impact of annosus root disease

Thinning aggregates A and B will help reduce the stress on the trees caused by crowding and the added stress caused by root disease. Aggregation A should be thinned to at least 200 sq.ft. basal area and aggregation B to 265 sq.ft. This is 70 percent of normal. For marking guidelines, trees with the healthiest crowns should be retained. True fir with numerous dead branches in the live-crown, low live-crown ratios, poor needle retention or fading foliage should be removed. Pine and incense cedar should be favored for retention followed by Douglas fir and then true fir. Oaks should be retained where armillaria root disease may move from oak trees to desired regeneration or healthy crop trees. Clumps of oak trees can be thinned to improve the vigor of individual oak trees. Since annosus root disease is in the fir root systems, it is not necessary to treat true fir stumps with Sporax to kill annosus spores. If healthy appearing true fir or Douglas fir trees are harvested and they are adjacent to healthy appearing true fir or Doulas fir, it is advisable to treat those freshly-cut stumps with Sporax. Freshly cut pine and incense cedar stumps should be treated with Sporax to prevent the establishment of the p-type *H. annosum.*

Removal of all true fir and Douglas fir to eliminate annosus root disease
In order to eliminate s-type *H. annosum*, all of the hosts (true firs and Douglas firs) need to be removed and replaced with non-hosts (pine, incense cedar, oak). After 30 years, when all of the s-type *H. annosum* has died in the roots, true fir and Douglas fir can be re-established. Oaks should be retained where armillaria root disease may move from oak trees to desired regeneration or healthy crop trees. Clumps of oak trees can be thinned to improve the vigor of individual oak trees. Freshly cut pine and incense cedar stumps should be treated with Sporax to prevent the establishment of the p-type *H. annosum.* Note: annosus root disease in either aggregation A or B does not appear severe enough to warrant this level of treatment. This treatment is usually used in stands that are devastated by annosus root disease.

If you need further help or have any questions, please call me at 252-6680 or e-mail me at wwoodruff@fs.fed.us.

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